# DPW-8 & AePW-4

# Buffet Working Group


May 6, 2024

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AIAA
SHAPING THE FUTURE OF AEROSPACE

# Buffet Working Group Leadership Team

- Hadar Ben-Gida, Technion Israel Institute of Technology 🇮🇱
- Brent Pomeroy, NASA Langley 🇺🇸
- Daniella Raveh, Technion Israel Institute of Technology 🇮🇱
- Bret Stanford, NASA Langley 🇺🇸
- Andrea Sansica, JAXA 🇯🇵

# Two Joint Working Groups

### Static Aeroelastic Deformation

1. Collaborative effort with both communities
2. Compute fluid/structure interactions in linear regime

Ben Rider, Stefan Keye, Garrett Mchugh

### Unsteady Aerodynamics and Buffet

1. Collaborative effort with both communities
2. Compute unsteady flowfield (fixed geometry)
3. Compute fluid/structure interactions in linear regime and past pitchup

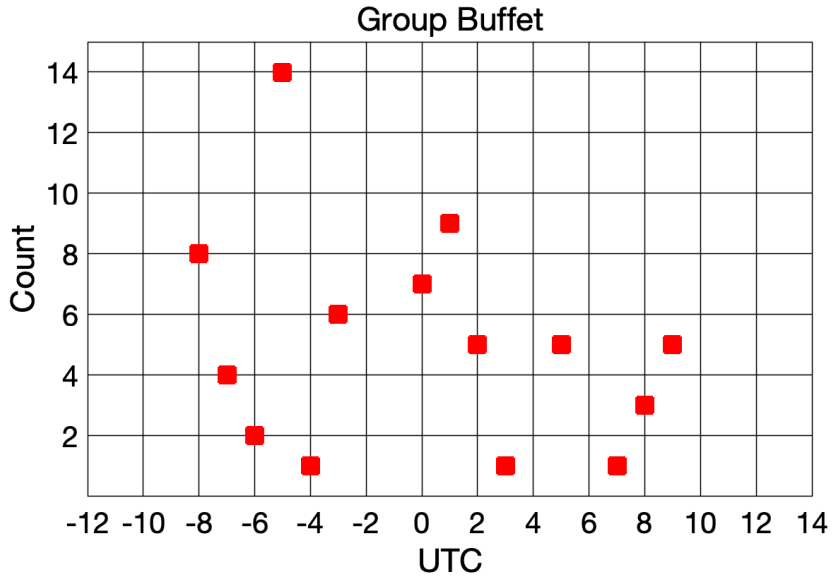
Hadar Ben-Gida, Brent Pomeroy, Daniella Raveh, Andrea Sansica, and Bret Stanford

# Vision

- **Leverage knowledge from both fields to advance state of the art**
  - Increase understanding within each field, individually
  - Synthesize methods to increase understanding of buffet predictions
- **Determine practices that accurately resolve unsteady, fixed-geometry at buffet conditions**
- **Exercise capabilities of solvers to simulate unsteady FSI buffet**
- **To provide an impartial forum for evaluating the effectiveness of existing tools and methods**
- **Provide guidance for simulations while relying upon users to implement his/her code's best practices**
- **Establish workshop model for future multidisciplinary communities**

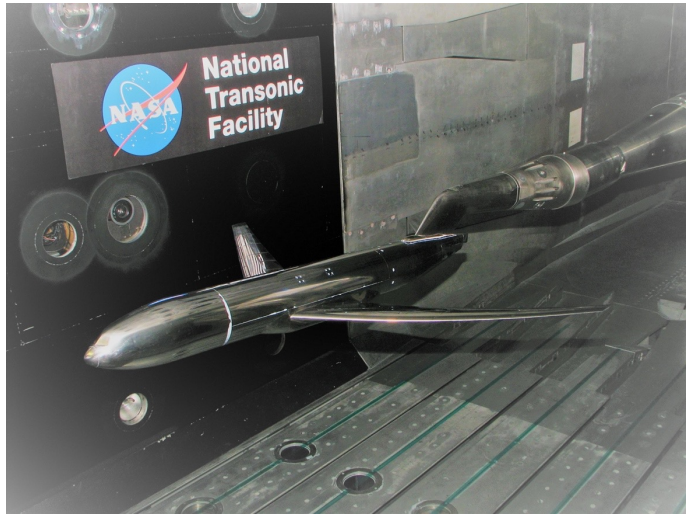
# Participant Summary

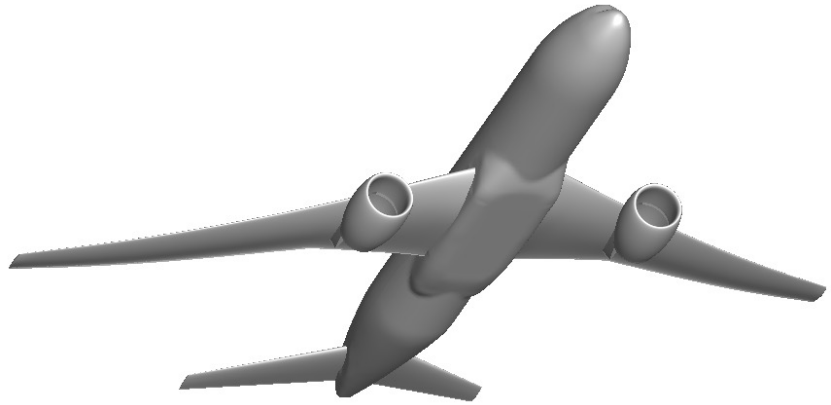
- **127 workshop respondents to date**
- **77 signed up for Buffet Working Group meeting series**
  - Please fill out SurveyMonkey link by the end of Thursday if you have not done so https://aiaa-dpw.larc.nasa.gov
  - Represent five continents
  - Most individuals are interested in multiple working groups
  - 47 also interested in Static Deformation Working Group



# DPW-8 and AePW-4 Configurations

- **NASA/Boeing Common Research Model**
  - Well studied and tested
  - Provides good comparison to other workshops
  - Rich legacy of NASA and Onera experimental data recently supplemented JAXA data
  - Finite element model available for NASA and JAXA models
- **Components**
  - Different working groups require various geometries
  - Will include: wing/body and wing/body/tail



# Schemes

- **Wide range of potential solvers**
- **Many users may use more than one scheme**
  - 47 RANS
  - 45 URANS
  - 35 hybrid RANS/LES
  - 19 LES/WMLES
  - And more

# Grids

- **Geometry**
  - High-quality CAD is being created or already exists, much from DPW-7
  - Available for download from the DPW website and JAXA website (link coming)
- **Common grids are being generated**
  - Strongly encourage use of committee-supplied grids
  - Cadence/Pointwise, Helden Aerospace, and NASA Ames (and you???)
  - User's best practices for solvers may require alternate grids
  - Submission to the workshop strongly desires any custom grids to be provided for posting on the website
- **Proposed topologies**
  - Mixed-element unstructured
  - All-tet unstructured
  - Structured overset multiblock
  - Structured (for all configurations???)
  - Hex dominant

# JAXA Experimental Data

- **Scaled-down NASA CRM tested in JAXA 2m x 2m transonic wind tunnel**
  - Reynolds numbers of 1.5 and 2.3 million
  - Rich data set of steady and unsteady data
- **Model details**
  - 80% scale NASA CRM (2.16% full-scale vehicle)
  - Wing/body/tail
  - Wind-off wing shape is the as-defined (in 2008) 1-G shape (same as NASA CRM)

| Data Set | Wing | Re | Alpha | Static, loaded deformation | F&M | Static Taps | Kulites | Oil Flow | Wake PIV | TSP | PSP | uPSP | Strain Gauge | FEM | Release Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A.1 | Steady | 2.3 | -2 to 6 every ~1.2 deg | X | X | X | | X | X | | | | | | Public |
| A.2 | Steady | 2.3 | -2 to 7 | X | X | X | | | | X | X | | | | Requested |
| B.1 | Unsteady Wing #1 | 1.5 | 4.84, 5.89 | X | X | | X | | | | | | | | Public |
| B.2 | Unsteady Wing #2 | 2.3 | -2 to 7 | | X | | X | | | | | X | X | X | Requested |

# New NASA Experimental Data

- **Planned test in NASA Ames 11-ft Transonic Wind Tunnel**
  - Currently scheduled for three weeks in Fall, 2025
  - Focused upon uPSP data collection
  - Collaborative effort between Boeing and NASA
  - Higher-Reynolds numbers will be tested
  - Wing/body and maybe wing/body/tail
- **New data set and modified model**
  - Provides opportunity for blind comparisons
  - CFD has a unique opportunity to inform the test matrix
  - Additional Kulite instrumentation will require a new FEM

# Test Case 1: Airfoil

- **Required**
- **ONERA OAT15A quasi-2D airfoil (10% chord)**
- **Reynolds number 3.0 million**
- **Use best practices for each solver, strongly prefer at least some variation of SA plus any other desired turbulence models**
- **Test Case 1a**
  - Consistent validation with the rest of the workshop including grid convergence
  - Steady RANS with some flavor of SA plus any other turbulence models
  - Pre-buffet
- **Test Case 1b**
  - Consistent methods and setup as will be used for other test cases
  - Unsteady CFD
  - Freedom for user to exercise best methods for his/her code(s)
  - Pre-buffet and post-buffet

# Test Case 2: Unsteady CFD, Static Wing

- **Optional**
- **Unsteady CFD with static geometry/grid**
- **Reynolds number 1.5 million**
- **CRM wing/body/tail**
- **Committee-supplied**
  - JAXA geometry at 4.84 and 5.89 degrees
  - NASA geometry at pre-buffet condition (perhaps $C_L$=0.50)
  - Grids for associated geometry
  - Trip location (optional to use)
- **Comparison metrics**
  - Time-averaged F&M and $C_P$ data
  - Unsteady pressure signals at select locations
  - Frequency content at select locations

# Test Case 3: Unsteady FSI

- **Optional**
- **Coupled unsteady CFD and dynamic geometry/grid**
- **Reynolds number 2.3 million**
- **Committee-supplied**
  - Undeformed jig geometry and grid
  - FEM model
  - Trip location (optional to use)
- **Comparison Metrics**
  - Time-averaged F&M and $C_P$ data
  - Unsteady pressure signals at select locations
  - Frequency content at select locations
  - Surface $C_P$ (uPSP)
  - Strain gauge
  - Structural response

# Test Case 4: NASA Ames Test

- **Optional**
- **Wing/body**
- **Unsteady CFD with static geometry/grid**
- **Reynolds number 5 million**
- **Blind simulations prior to the test**
- **Committee-supplied**
  - Pre-test grids and geometry (consistent with DPW-7)
  - Experimentally-measured test geometry (hopefully)
  - Updated FEM model including Kulite installation considerations
- **Comparison Metrics**
  - Time-averaged F&M and $C_P$ data
  - Unsteady pressure signals at select locations

# Nominal Schedule

- **May, 2024**
  - ONERA OAT15A geometry release
- **June, 2024**
  - ONERA OAT15A grids released
- **July, 2024**
  - First look of Test Case 2/3 grids
- **August, 2024**
  - AVIATION in-person meeting
- **Winter, 2024**
  - Mini Workshop 1
- **January, 2025**
  - SciTech in-person meeting
- **Summer/Fall, 2025**
  - Mini Workshop 2
  - NASA Ames 11-ft test
- **February, 2026**
  - Delivery of final data set (perhaps alternate submissions prior to this date)
- **June, 2026**
  - Workshop in San Diego, CA

# Working Group Meeting Cadence

- **Currently set up for 9:00 Eastern time on first and third Monday of each month**
  - Difficult to achieve suitable meeting time for global participants
  - Will consider alternate meeting times throughout course of workshop
- **Two recurring meeting invites**
  - One is for first Monday of the month
  - One is for the third Monday of the month
  - This was done so that one of the meetings can be moved to a different time in the future
- **No meeting May 20**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